TAP 602- 1: Ideal gases

(Ideal gas constant (R) = 8.3 mol^{-1} K^{-1})

1. Calculate the number of moles of a gas of pressure 10^{5} Pa at a temperature of 27°C occupying a volume of 5 m^{3}.

2. An ideal gas has a molar mass of 40 g and a density of 1.2 kg m^{-3} at 80 °C. What is its pressure at that temperature?

3. An ideal gas is contained in a metal cylinder with a volume of 0.25 m^{3} at a pressure of 15 x 10^{5} Pa and a temperature of 20 °C. If the gas is allowed to expand into the atmosphere at a pressure of 10^{5} Pa and a temperature of 15 °C what is its new volume?

Practical advice

Work through some examples reminding students that T is in Kelvin

Answers and worked solutions

1. Calculate the number of moles of a gas of pressure 10^5 Pa at a temperature of 27°C occupying a volume of 5 m^3.

   PV = nRT T = 273 + 27 = 300 K

   n = PV/RT = 105 x 5 / (8.3 x 300) = 200.8 = 201 moles

2 An ideal gas has a molar mass of 40 g and a density of 1.2 kg m^{-3} at 80°C. What is its pressure at that temperature?

   T = 273 + 80 = 353 K

   PV = nRT

   m = ρV

   so V = 0.04 / 1.2 with n = 1 (since 1 mole of gas has a mass of 40 g, or 0.04 kg)

   P = RT/V = 8.3 x 353 x 1.2/0.04 = 8.79×10^4 Pa

3. An ideal gas is contained in a metal cylinder with a volume of 0.25 m^3 at a pressure of 15×10^5 Pa and a temperature of 20^oC. If the gas is allowed to expand into the atmosphere at a pressure of 10^5 Pa and a temperature of 15°C what is its new volume?

   T_1= 273+ 20 = 293 K T_2= 273+ 15 = 288 K

   $$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$ $15 \times 10^5 \times 0.25 / 293 = V_2 \times 10^5 / 288$

   Therefore: V_2 = 15 x 0.25 x 288 / 293 = 3.69 m^3

External reference

This activity is taken from Resourceful Physics